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|---|---|---|---|
| **Project** | Fabrication and Characterization of Nanoelectronic Devices and Circuits | | |
| **Owner** | Jan-David Fischbach | **Start Date** | 14.05.2021 |
| **Page** | 1/4 | **Revised Date** | July 28, 2021 |
| **Samples** | | | 6 SOI samples, 6 bulk samples |

Institute of Semiconductor Electronics

RWTH AACHEN UNIVERSITY

## Session 1 - 12.5.21

Determination of RIE etch parameters

| Nr. | Description | Tool | Operator | Date | Duration | Parameters |
|---|---|---|---|---|---|---|
| 1. | start material | | | | | 1.5 cm×1.5 cm bulk Si sample pieces diced from 12" Si wafer |
| 2. | Lithography | Resist wet bench, MA4 IHT, Fume Hood | JD Fischbach | 12.5.21 | 30:00 | HMDS coat @ °C for 19 Steps (including dehydration during heatup)<br>Spin Coat AZ5214e: 3 sec @1000 rpm, 1 min @4000 rpm<br>90 sec soft-bake @95 °C<br>exposure 7.5 sec @ 15$mW/cm^2$ and 405nm<br>development: 50 sec in MIF726 |
| 3. | RIE Etch | Cobra Oxford | JD Fischbach | 12.5.21 | 1:00:00 | 1. Venting load lock<br>2. DESCUM (Oxigen plasma) for sharper etch edges:<br>20 sccm $O_2$ for 2 min @ 45°C with 10 W HF power<br>3. SF6: p=15 mTorr; HF=20 W; SF6: 37.5 sccm; $O_2$: 11 sccm<br>4. Resist strip: 1.5 kW ICP for 8 min 50 sccm $O_2$ |
| 4. | Profilometry | Dektak | JD Fischbach | 12.5.21 | 30:00 | stylus force: ? scan speed: ? range: 6 $\mu$m results see figure 1 |

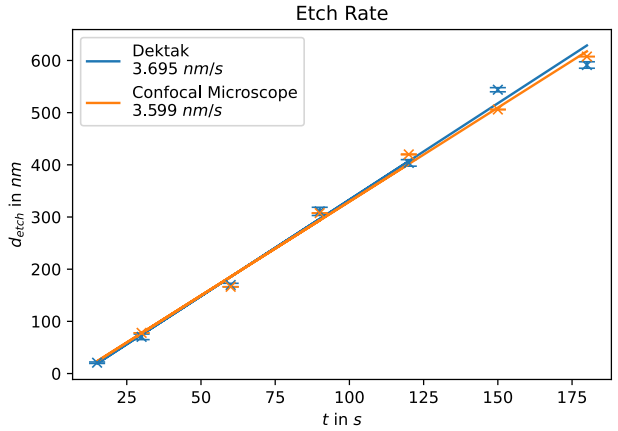


Figure 1: Estimation of the etch rate from dektak and confocal microscope measurements

## Session 2 - 19.5.21

Determination of Deal Grove model parameters

| Nr. | Description | Tool | Operator | Date | Duration | Parameters |
|---|---|---|---|---|---|---|
| 1. | start material | | | | | 1.5 cm×1.5 cm bulk Si sample pieces from last session |
| 2. | Pre clean | ZMNT R001 | Jan-David Fischbach | 19.5.21 | 30 min | Acetone for 10 min @ 120°C<br>Isopropanol for 10 min @ 120°C<br>DI rinse for 10 min @ Roomtemperature |
| 3. | RCA clean | ZMNT R001 | Jan-David Fischbach | 19.5.21 | 2 h | piranha solution: 150 ml $H_2SO_4$+ 50 ml $H_2O_2$, 10 min<br>DI water rinse 10 min<br>HF (1%) till surface is hydrophobic 100...150 ml ca. 20 sec<br>DI water rinse 5 min<br>SC-1: 125 ml $H_2O$ + 25 ml $NH_3(aq)$ + 25 ml $H_2O_2$: 10 min<br>DI water rinse 10 min<br>HF (1%) till surface is hydrophobic 100...150 ml ca. 20 sec<br>DI water rinse 5 min<br>SC-2: 150 ml $H_2O$ + 25 ml $HCl$ + 25 ml $H_2O_2$: 10 min<br>DI water rinse 10 min |
| 4. | RTA | RTA | Jan-David Fischbach | 19.5.21 | - | vent load lock, insert, pump down (2 stages (2nd stage: Turbo molecular pump))<br>2000sccm $O_2$, 1000°C, 50°C/s ramp, 90 sec and 150 sec @ 1000°C |
| 5. | Ellipsometry | Ellipsometer | Jan-David Fischbach | 19.5.21 | - | See results in figure 2. |

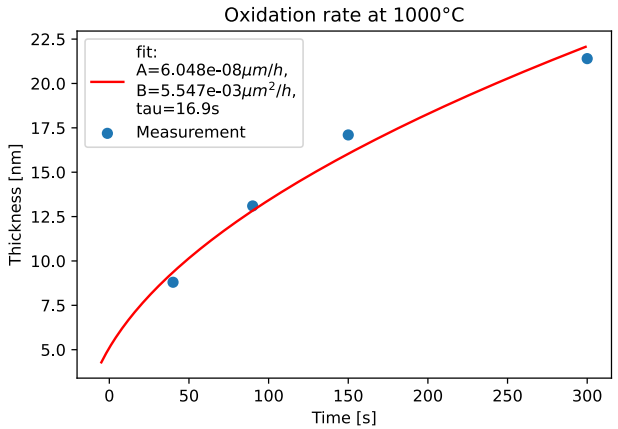


Figure 2: Estimation of the Deal Grove model parameters

## Session 3: Active area (mesa) definition of SOI samples

| Nr. | Description | Tool | Date | Duration | Parameters |
|---|---|---|---|---|---|
| 1. | HMDS Coating | HMDS coater | 02.06.2021 | 5-8 min | 135°C |
| 2. | Photoresist Coating | spin coater | 02.06.2021 | 4 sec<br>60 sec | 1000 rpm<br>3000rpm |
| 3. | Soft bake | hot plate | 02.06.2021 | 90 sec | 95°C |
| 4. | Optical lithography | laser scanner | 02.06.2021 | 14 min | 405 nm<br>30% transmission 1505 mJ/cm$^2$ 25.3 °C<br>4step-752 mJ/cm$^2$ |
| 5. | Post exposure bake | hot plate | 02.06.2021 | 90 sec | 125 °C |
| 6. | Development | wet bench | 02.06.2021 | 45 sec | Developer MIF AZ726<br>rinse with DI water |
| 7. | Reactive ion etching | ICP-RIE (PlasmaPro 100 cobra) | 02.06.2021 | 100 sec | 15mTor<br>20W |
| 7. | Reactive ion etching from another group | ICP-RIE | 02.06.2021 | 120 sec | Descum<br>Pressure:10 mTor<br>HF:10W<br>$O_2$:20 sccm He Backing:10 sccm<br>Temp:45°C |
| 7. | Reactive ion etching | ICP-RIE (PlasmaPro 100 cobra) | 02.06.2021 | 100sec, 30sec | Si-etch, SF6/O2<br>Etchrate: 3.7nm/s<br>Target depth: 340nm/80nm<br>Pressure:15mTor<br>HF:20W<br>ICP:0W SF6:37.5sccm $O_2$:11 sccm<br>He Backing:10sccm, Temp:45°C |

## Session 4: Formation of gate dielectrics

| Nr. | Description | Tool | Date | Duration | Parameters |
|---|---|---|---|---|---|
| 1. | RCA clean | | 09.06.2021 | | Piranha etching<br>piranha solution: 150 ml $H_2SO_4$ + 50 ml $H_2O_2$, 10 min<br>DI water rinse 10 min<br>1 % HF till surface is hydrophobic, 20 sec<br>DI water rinse 10 min<br>SC-1: 125 ml $H_2O$ + 25 ml $NH_4OH$ + 25 ml $H_2O_2$: 10 min<br>DI water rinse 10 min<br>1 % HF till surface is hydrophobic, 20 sec<br>DI water rinse 10 min<br>SC-2: 150 ml $H_2O$ + 25 ml HCl + 25 ml $H_2O_2$: 10 min<br>DI water rinse 10 min |
| 2. | Oxidation | | 09.06.2021 | 130 sec | To obtain 15 nm $d_{ox}$ |

## Session 5: Image reversal process: nickel contact structuring (lift-off)

| Nr. | Description | Tool | Date | Duration | Parameters |
|---|---|---|---|---|---|
| 1. | dehydration bake | HMDS coater | 18.06.2021 | 5 min | 120°C |
| 2. | HMDS Coating (HMDS_01) | HMDS coater | 18.06.2021 | | 135°C |
| 3. | Spin coat AZ5214e | spin coater | 18.06.2021 | | 3 s @1000 rpm; 30 s @3000 rpm |
| 4. | Soft Bake | hot plate | 18.06.2021 | 1:30 min | 95°C |
| 5. | Exposure | MA4 IHT | 18.06.2021 | 2 sec | 15 mW/$cm^2$ 405 nm |
| 6. | reverse Bake | hot plate | 18.06.2021 | 2 min | 115°C |
| 7. | flood exposure | MA4 IHT | 18.06.2021 | 15 sec | 15 mW/$cm^2$ 405 nm |
| 8. | developement | Wet bench | 18.06.2021 | 36 sec | AZ726 MIF |

## Session 6: Lift-off, silicidation and definition of gate electrode

| Nr. | Description | Tool | Date | Duration | Parameters |
|---|---|---|---|---|---|
| 1. | Lift-off of aluminum layer | | 24.06.2021 | | Bathe with Acetone and Propanol<br>Flush with syringe<br>Dehydration 150°C |
| 2. | Primer coating (HDMS) | | 24.06.2021 | 3 sec<br>1 min | 1000rpm<br>6000rpm |
| 3. | Soft bake | hot plate | 24.06.2021 | 90sec | 95°C |
| 4. | Photoresist coating (AZ S214B) | spin coater | 24.06.2021 | 3 sec<br>60 sec | 1000rpm<br>3000rpm |
| 5. | Soft bake | hot plate | 24.06.2021 | 90sec | 95°C |
| 6. | Edges removal with q-tips dipped in acetone | q-tip | | 24.06.2021 | |
| 7. | Overlay Alignment | | 24.06.2021 | | |
| 8. | Short Exposure | | 24.06.2021 | 2 sec | Hg lamp 405 nm |
| 9. | Reverse bake | | 24.06.2021 | 2min | 120°C |
| 10. | Flood Exposure | | 24.06.2021 | 15sec | |
| 11. | Development | wet bench | 24.06.2021 | 36 sec | MIF 726<br>DI water rinse for a few minutes |